REMARKS

Claims 1 and 2 are pending in the Application.

Claim 1 is amended.

Claim 2 is withdrawn from consideration pursuant to a Restriction Requirement.

Applicant wishes to thank Examiner Hai Vo for the courteous and professional interview conducted with Applicant's undersigned representative, Mr. Kenneth M. Fagin, on October 3, 2003. It is a purpose of these remarks to make of record and build on what transpired at the interview.

At the interview, the Office Action of June 24, 2003 was discussed. With reference thereto, claim 1 stands rejected under 35 U.S.C. § 103 as unpatentable over Karande et al. (U.S. Patent No. 5,717,000) taken alone or in view of Okada et al. (U.S. Patent No. 4,739,007) as evidenced by Claytone Chemistry. As pointed out at the interview, the instant invention teaches at page 8, lines 1-6 that the exfoliation (delamination and dispersion) of the layered mineral particles into constituent layers does not need to be complete:

> *"The exfoliation of layered mineral particles into constituent layers need not be complete in order to achieve the objects of the present invention. The present invention contemplates that at least 99% of the particles should be less than about 30 nanometers (30 layers or platelets) in thickness, and that more than about 50% of the particles should be less than about 20 nanometers (20 layers or platelets) in the thickness direction."*

Hence, claim 1 of the present invention recites that "each of said reinforcing particles having one or more layers of 0.7nm-1.2nm thick platelets, wherein more than about 50% of the reinforcing particles are less than about 20 layers thick, and wherein more than about 99% of the reinforcing particles are less than about 30 layers thick."

Claim 1 is amended as proposed during the interview by adding the limitation "wherein at least some of the reinforcing particles are not completely exfoliated" to distinguish the invention more clearly from the cited prior art.

Karande et al. disclose dispersions of delaminated particles in polymer foams so that at least a portion of the polymer intercalates between layers of the particles.

Okada et al. disclose a composite material with high mechanical strength and excellent high-temperature characteristics comprising a polymer matrix containing polyamide and layers of a silicate uniformly dispersed in the order of molecules in the polymer matrix.

The naturally occurring geometry of layered silicates or clay particles is a stacked geometry of individual platelets. In clay soils, clay particles are typically arranged along a horizontal plane in a plate-like structure. When these horizontal aggregations are stacked high and consolidated over time, they can be quite tight and sticky. It is generally accepted in the prior art that the preparation of nanocomposites requires extensive delamination of the layered clay structure and complete dispersion of the resulting platelets throughout the polymer matrix. Thus, it is believed that consistent improvements in the properties of clay loaded polymeric systems can be achieved by minimizing clay aggregation as much as possible, promoting the formation of chemical bonds between polymer and clay and achieving an exfoliation of the layered silicate or clay mineral. In accordance with the prior art, an exfoliated nanocomposite is the most desirable structure. As stated heretofore, nanocomposites are obtained by dispersing clay particles in a polymer matrix. The prior art provides evidence that exfoliation and dispersion of clay platelets during nanocomposite preparation and clay matrix adhesion are major technical issues that need to be addressed in order to achieve the desired property enhancements in polymer-clay nanocomposites [P.B. Messersmith, E.P. Giannelis, Chem. Mater. 5, 1064 (1993); H. Shi, T. Lan, and T. Pinnavaia, Chem. Mater. 8, 2216 (1996); I.J. Chin, T. Thurn-Albrecht, H.C. Kim, T.P. Russell, Polymer, 42, 5947 (2001); J.M. Brown, D. Curliss, and R.A. Vaia, Chem. Mater. 12 (11), 3376 (2000); C. Zilg, R. Thomann, J. Finter, and R. Mulhaupt, Macromol. Mater. Eng. 280, 41 (2000); and X. Fu and S. Qutubuddin, Polymer, 42 (4), 807 (2001)]. Therefore, the prior art discloses methods to improve exfoliation to achieve complete or almost complete exfoliation. In an exfoliated structure, the layers of the silicate or clay mineral are completely separated and the individual layers are distributed throughout the polymeric matrix. In such nanocomposites, the interfacial effect between the silicate layers and matrix polymers is a key factor leading to high stiffness, high modulus and heat resistant composites [P.B. Messersmith, E.P. Giannelis, Chem. Mater. 6, 1719 (1994)] which can be by far superior to conventional glass fiber reinforced plastics, provided that the silicate layers are completely exfoliated and thoroughly homogenized into the polymer matrix [M. Okamoto et al., Polymer 41 (2000) 3887-3890]. However, usually very strong electrostatic interactions between silicate layers through intergallery cations make it extremely difficult to achieve complete exfoliation of the layers. Therefore, the prior art discloses efforts to avoid this difficulty and to achieve an exfoliation of the particles through the development of a compatibilizer chemistry as

a key factor in the expansion of this nanotechnology, for example, by replacing such cations by some quarternized ammonium salts.

Karande et al. states at column 1, lines 10-12, that their invention relates to polymer foams from resins having dispersed therein delaminated or exfoliated organophilic multi-layered particles. Karande et al. further goes on to define nanocomposites at column 1, lines 13-15, as compositions comprising single layers such as silicate layers (about 1 to 100 nm thick) dispersed in a continuous polymer matrix. The polymer foam as, taught by Karande et al., can be prepared by the steps of dispersing organophilic multi-layered particles into a melt comprising an olefinic or styrenic polymer having polar functionality so that at least a portion of the polymer intercalates between layers of the particles (column 1, line 66 – column 2, line 3).

In contrast, the present invention states that the exfoliation of layered mineral particles into constituent or single layers/platelets does not need to be complete. Hence, claim 1 defines that the reinforcing particles have one or more layers of 0.7nm-1.2nm thick platelets, wherein more than about 50% of the reinforcing particles are less than about 20 layers thick, and wherein more than about 99% of the reinforcing particles are less than about 30 layers thick. Amended claim 1, as supported by the specification as originally filed at page 8, lines 1-6, further recites that at least some of the reinforcing particles are not completely exfoliated to more clearly distinguish the present invention from the cited prior art. All claim limitation must be taught or suggested by the prior art in order to establish obviousness. Applicant respectfully submits that Karande et al. taken alone or in view of the general state of the art as discussed heretofore does not teach that the exfoliation of the layered particles does not need to be complete. Karande et al. can actually be viewed as teaching away from the present invention since the organophilic multi-layered particles of the polymer foam are delaminated or exfoliated and the present invention teaches that exfoliation of the reinforcing particles does not need to be complete. The totality of the prior art must be considered, and proceeding contrary to accepted wisdom in the art is evidence of non-obviousness.

Okada et al. discloses a composite material comprising a polymer matrix containing polyamide and layers of a silicate uniformly dispersed in the order of molecules in the polymer matrix, each of said silicate layers of said dispersed silicate being 7 to 12 Angstroms (0.7 to 1.2nm) thick and the interlayer distance of said silicate layers in the dispersed silicate being at least 20 Angstroms (2nm) (abstract; column 2, lines 41-46; column 3, lines 37-43; claim 1). Okada et al. further states at column 8, lines 13-17 that the silicate layers are finely dispersed in the order of magnitude of molecular dimensions (in a thickness of 10 Angstroms (1nm) or so) and are firmly combined with the chains of organic molecules. A thickness of about 10

Angstroms or 1 nm of the phyllosilicate in Okada et al. corresponds to about one layer of the phyllosilicate. Okada et al. clearly teaches that the silicate layers are uniformly dispersed. This means that the silicate layers are dispersed into the individual single clay layers having a thickness of about 1nm. In an exfoliated structure, the layers of the silicate or clay mineral are completely separated and the individual layers are distributed throughout the polymeric matrix. Again, this is in contrast to the present invention as defined in amended claim 1 reciting that each of said reinforcing particles has one or more layers of 0.7nm-1.2 nm thick platelets, wherein more than about 50% of the reinforcing particles are less than about 20 layers thick, wherein more than about 99% of the reinforcing particles are less than about 30 layers thick, and wherein at least some of the reinforcing particles are not completely exfoliated. Thus, it is respectfully submitted, that Okada et al. does not disclose a platelet particle that has a thickness meeting the claimed range. Okada et al., as well as Karande et al., can actually be viewed as teaching away from the present invention as defined in amended claim 1.

The instant invention as defined in claim 1 discloses that the exfoliation of layered mineral particles into constituent layers does not need to be complete. This is in contrast to the teachings of the prior art where it is stated that complete or nearly complete exfoliation is a key factor in achieving nanocomposites with enhanced properties. Furthermore, this provides advantages over the prior art since it reduces the efforts in achieving an exfoliation of the layered mineral particles and hence it reduces the time and cost of providing reinforcing particles in accordance with the present invention. The exfoliation process can be conducted in different specific ways to achieve different degrees of exfoliation with different particle thickness ranges. The specification as originally filed states at page 6, lines 15-16 that in order to exfoliate the larger mineral particles into their constituent layers, different methods may be employed. Moreover, the fact that the same clay mineral is used in the same general process does not mean that the exact same results would inescapably be obtained in all cases. The statement in the Office Action that "products of identical chemical composition can not have mutually exclusive properties" is inapposite.

The particles disclosed by Karande et al. and Okada et al. are a finer fraction of layered mineral particles, viz. single layer delaminated or exfoliated particles and uniformly dispersed individual or single clay layers having a thickness of about 1nm, respectively. In accordance with the present invention as defined in claim 1, the reinforcing particles can be more coarse in comparison to Karande et al. and Okada et al., viz. at least 50 percent are less than about 20 layers thick, at least 99% of said reinforcing particles are less than about 30 layers thick, and at least some of the reinforcing particles are not completely exfoliated.

Thus, Applicant submits, that Karande et al. and Okada et al. may actually be viewed as teaching away from the instant invention as claimed, in which it was found that exfoliation of the layered mineral particles into constituent layers does not need to be complete, as reflected by the claim-specified values. Therefore, the prior art does not provide any motivation to provide reinforcing particles in which the exfoliation of the layered mineral particles is not complete. Applicant submits, therefore, that the present invention would not have been obvious in view of the teaching of the prior art and that the range of the layer distribution within the platelet particle (more than about 50% of the reinforcing particles are less than about 20 layers thick, more than about 99% of the reinforcing particles are less than about 30 layers thick, and at least some of the reinforcing particles are not completely exfoliated) would not invariably be inherently present in the reinforcing particles of Okada et al.

The Claytone Chemistry article cited in the Office Action provides a general overview of the smectite group of clay minerals describing, inter alia, particle size, particle charge, aggregates, and hydration of smectite crystals. Fig. 6 of this article shows a smectite aggregate and a description of dispersion is provided in conjunction with this figure. The article states that a high degree of dispersion is needed to expose the individual platelets thus bringing the large surface area of the clay platelets in contact with the water. These platelets, as they occur in nature, are stacked surface to surface. If dispersion is not accomplished, the surface area is greatly diminished, thus reducing the affect of the clay surface itself. Additionally, this will lead to relatively large undispersed smectite agglomerates. The teaching of this article provides further support for prior art efforts that exfoliation and dispersion of clay platelets during nanocomposite preparation and clay matrix adhesion are major technical issues that need to be addressed in order to achieve the desired property enhancements in polymer-clay nanocomposites. However, the article provides no disclosure that the exfoliation of the layered mineral particles into constituent or single layers/platelets does not need to be complete in order to achieve the objects of the present invention.

In view of the foregoing, Applicant traverses the rejection of claim 1 and respectfully requests that it be withdrawn. Timely and favorable reconsideration and Notice of Allowance are earnestly solicited.

The specification is amended on page 6, line 14 to identify the trademark CLAYTONE® HY.

Please charge any fees associated with the submission of this paper to Deposit Account Number 033975. The Commissioner for Patents is also authorized to credit any over payments to the above-referenced Deposit Account.

Respectfully submitted,

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